Remarks

Reconsideration of the application, and allowance of all claims pending are respectfully requested. Claims 1-20 are pending.

Examination of Previously Presented Claims 14-20

In the Response to Office Action submitted on July 12, 2005, applicants submitted new claims 14-20. The Office Action mailed on September 20, 2005 did not acknowledge claims 14-20 in the Office Action Summary nor in the Detailed Action.

Applicants respectfully request examination of previously presented claims 14-20.

Claim Rejections - 35 U.S.C. § 103

Claims 1, 3, 4, 6-9, and 11-13 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Fallahi et al. (U.S. Patent No. 6,436,613; "Fallahi") in view of Hopfer et al. (U.S. Patent No. 5,339,369; "Hopfer"). Claim 2 was rejected under 35 U.S.C. §103(a) as being unpatentable over Fallahi and Hopfer in further view of Hobbs et al. (U.S. Patent No. 6,870,624; "Hobbs"). Claims 5 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fallahi and Hopfer in further view of Yoshida et al. (U.S. Patent No. 6,822,982; "Yoshida"). These rejections are respectfully, but most strenuously, traversed.

If further clarification of the presented arguments, claimed technical features, or the differences over the cited prior art is needed to advance prosecution, the Examiner is invited to call applicants' attorney to request a telephone conference with one or more of the applicants, applicants' attorney, the Examiner, and the Examiner's supervisor.

Applicants respectfully submit that the Office Action's citations to the applied references, with or without modification or combination, assuming, *arguendo*, that the modification or

combination of the Office Action's citations to the applied references is proper, do not teach or suggest the semiconductor modulator for modulating the optical wave with the RF signal comprising … first and second diffraction gratings slowing the optical wave to match its speed to the speed of the RF signal in the electrodes, as recited in applicants' independent claim 1.

For explanatory purposes, applicants discuss herein one or more differences between the claimed invention and the Office Action's citations to Fallahi, Hopfer, Hobbs, and Yoshida. This discussion, however, is in no way meant to acquiesce in any characterization that one or more parts of the Office Action's citations to Fallahi, Hopfer, Hobbs, and Yoshida correspond to the claimed invention.

Fallahi (column 14, lines 6-28; FIG. 17) discloses:

> FIG. 17 shows schematically the generic arrangement of a laser diode section 60, surface resonator 62, and electrically controlled grating outcoupler 64. The laser diode section generates light across a p-i-n section in the laser material substrate. The laser diode or gain section 60 section includes a contact 66, a p-type region 68, an i or intrinsic region 70 which could include for example multiple quantum well structures, and a n-type region 72 with a backside contact 74. Forward-bias current in the laser diode section injects electrons into the intrinsic region which recombine, with electrons to generate light. The **light is then resonated between two feedback gratings** 76 adjacent to the gain region 60, thereby **forming a resonator with the feedback gratings serving as partial reflectors. Light partially transmitted by the feedback gratings 76 as laser light is diffracted by a grating outcoupler** 78 towards a direction almost normal from the outcoupler. On top the grating outcoupler is a transparent electrode 80 such as for example indium tin oxide. A bias (i.e, a voltage bias or current injection) into the transparent conductive film, as shown by the arrows in FIG. 17, alters the refractive index and changes the diffraction conditions, thus changing the direction of output light from the grating outcoupler. (emphasis added)

Fallahi (Abstract, lines 3-5) further discloses:

> … a sol-gel glass multimode interference region coupled to and contiguous with the input region and configured to accept and

> **replicate the input light as multiple self-images**... (emphasis added)

Applicants now refer to "http://en.wikipedia.org/wiki/Optical_cavity" (included with an information disclosure statement), which recites (lines 1-3):

> An optical cavity or **optical resonator** is an arrangement of mirrors that forms a **standing wave cavity resonator** for light waves. Optical cavities are a major component of lasers, surrounding the gain medium and **providing feedback of the laser light**. (emphasis added)

Fallahi discloses the laser diode, the resonator, and the outcoupler. Applicants suggest that the feedback grating of Fallahi provides the feedback of the laser light and the multiple self-images correspond to the standing wave. The input light is resonated between the feedback gratings forming an optical resonator. As the input light is reflected between the feedback gratings, the standing wave is formed (e.g., multiple self-images). Laser light is transmitted by the feedback gratings to the outcoupler. The input light is reflected back across itself to achieve the multiple self-images for creation of the laser light. Introducing an optical waveguide, for example, directed into the page of Fallahi's FIG. 17, would destroy the capability for creation of the standing wave and destroy the creation of laser light (e.g., outputting the multiple self-images, Abstract, lines 8-9).

Applicants suggest that Fallahi is not directed towards the same purpose and fails to teach a semiconductor modulator. The current injection method via the electrodes disclosed by Fallahi is not capable of high speed RF modulation, as is known in the art. Fallahi also fails to disclose that the diffraction gratings are for slowing the optical wave to match speed of an RF signal in the electrodes. In addition, there is no way to match the speeds of a lightwave and RF wave if the lightwave is resonating, as is known in the art.

So, the Office Action's citation to Fallahi fails to satisfy at least one of the limitations recited in applicants' independent claim 1.

Hopfer (Abstract, lines 1-7) discloses:

> An improved high-speed external optical modulator, modulated by RF waves, which velocity matches the RF waves with the optical waves is disclosed. The apparatus includes a lithium niobate substrate on which is formed an optical waveguide, electrically floating electrodes, a low dielectric buffer layer and electrodes carrying the modulating RF energy.

Hopfer further discloses (FIG. 3; column 4, lines 7-21):

> In the preferred embodiment three (3) floating electrodes 32, 33, 34, are employed and are situated substantially parallel to the optical waveguides in a modulator of the Mach-Zehnder configuration (see FIG. 3). The preferred width of the center electrode 34 is approximately fifty (50) microns while the outer floating electrodes 32, 33 are approximately 100 microns wide. There is approximately a twenty-five (25) micron gap between the center floating electrodes 34 and each outer electrode 32, 33.
>
> The floating electrodes 32, 33, 34 are approximately the same length as the interaction distance. The optical waveguides 18, 20 are situated substantially underneath the gaps in the floating electrodes.

Hopfer discloses the optical waveguide and transmission line electrodes that run parallel to the optical waveguide.

Hopfer further discloses (column 3, lines 49-65; FIG. 2):

> FIG. 2 shows a cross-section of a modulator of this invention using the Mach-Zehnder design. A dielectric buffer layer 30 is situated between the RF electrodes 22, 24 and the substrate 16. The dielectric buffer layer 30 has a dielectric constant (.epsilon.) lower than the dielectric constant of the substrate 16. **The velocity of the RF waves increases** since the effective dielectric constant has been lowered. The preferred buffer layer material is a polyimide, for example, Dupont TI2611 with a .epsilon.=2.7. The thickness of the dielectric buffer layer 30 is approximately ten (10) microns. In this invention, the RF electrodes 22, 24 are electroplated over the dielectric buffer layer 30. The buffer layer 30 creates a medium for the RF wave that has

> the same effective dielectric constant as the medium in which the optical wave travels. **This has the effect of velocity matching the RF wave with the optical wave.** (emphasis added)

Hopfer discloses increasing the velocity of the RF wave in order to match the velocity of the RF wave with that of the optical wave. Hopfer fails to disclose slowing the optical wave to match the velocity of the RF wave and the optical wave.

In addition, applicants submit that Hopfer and Fallahi are not combinable. The electrodes disclosed by Fallahi are not configured for transmission of an RF signal such as the RF signal of Hopfer. The electrodes of Fallahi are not parallel to a waveguide as required by Hopfer for RF modulation of the optical wave over an interaction distance (Hopfer, column 3, lines 2-5). Also, Hopfer discloses an *external* modulator, whereas Fallahi discloses an *integrated* hybrid optoelectronic device.

So, the Office Action's citation to Hopfer fails to satisfy at least one of the limitations recited in applicants' independent claim 1.

Hobbs (Abstract, lines 1-8) discloses:

> An apparatus for filtering electromagnetic waves, the apparatus comprising a substrate having a surface relief structure containing at least one dielectric body with physical dimensions smaller than the wavelength of the filtered electromagnetic waves, such structures repeated in a two dimensional array covering at least a portion of the surface of the first substrate. Also disclosed is a material sensor utilizing this apparatus.

Hobbs discloses filtering of electromagnetic waves for the purpose of a material sensor. Hobbs fails to disclose diffraction gratings for slowing down an optical wave to match a speed of an RF wave. In addition, Hobbs (column 1, lines 52-59) teaches away from use of the Bragg grating disclosed by Hopfer:

> Using a surface structure resonance phenomena, the optical filters described herein can be used to produce biosensors capable of detecting minute concentrations of chemicals through a shift in

> the wavelength of light resonated from the sensor's surface. **This type of response cannot be obtained from other filtering methods** such as thin-film interference filters and fiber Bragg grating filters. (emphasis added)

So, the Office Action's citation to Hobbs fails to satisfy at least one of the limitations recited in applicants' independent claim 1.

Yoshida (column 9, lines 1-28; FIG. 8) discloses:

> FIG. 8 is a side cross-sectional view showing the structure of a semiconductor laser device 130 according to a fourth embodiment of the present invention. FIG. 8 is substantially identical to the structure of FIG. 1, with the exception of the active layer 3'. In the embodiment of FIG. 8, the active layer 3' comprises a self-organized Quantum dot structure. The effect of the quantum dot structure on the wavelength range of a single mode laser has been described in InAs/GaInAs quantum dot DFB lasers emitting at 1.3 .mu.m, Klopf et al., IEEE Electronics Letters, Vol. 37, No. 10 (10 May, 2001), and InGaAs/AlGaAs quantum dot DFB lasers operating up to 213.degree. C., Kamp et al., IEEE Electronics Letters, Vol. 35, N. 3 (Nov. 11, 1999), the entire content of these references being incorporated herein by reference. According to this structure, the active layer 3' has an inhomogeneously broadened optical gain spectrum due to a size fluctuation of the dots, and therefore offers a wider range of gain than quantum well lasers. Thus, a tuning range of approximately 40 nm, for example, may be achieved for the center wavelength. However, the precise tuning range is determined by the size fluctuation of the self-assembled dot which depends on the growth conditions. As with embodiments previously discussed, this tuning range is achieved by varying the current in the area of the grating 13. Finally, as previously noted, while the electrical separation groove 16 shown in FIG. 8 does not reach to p-cladding layer, it is preferable to etch off the p-GaInAsP contact layer 7 at groove 16 to realize electrical isolation completely.

The semiconductor laser device 130 with the active layer 3' comprises the self-organized Quantum dot structure. Yoshida further discloses optical cavities, as discussed above with reference to Fallahi, at column 3, lines 23-30 and lines 60-66. Yoshida fails to disclose a semiconductor modulator for modulating an optical wave with an RF signal, as recited in applicants' independent claim 1. Additionally, the Office Action's citation to Yoshida does not

disclose electrodes receiving the RF signal and diffraction gratings slowing the optical wave to match its speed to the speed of the RF signal in the electrodes.

So, the Office Action's citation to Yoshida fails to satisfy at least one of the limitations recited in applicants' independent claim 1.

For all the reasons presented above with reference to claim 1, claims 1-3, 6-8, and 12 are believed neither anticipated nor obvious over the art of record. The corresponding dependent claims are believed allowable for the same reasons as independent claims 1-3, 6-8, and 12, as well as for their own additional characterizations.

Withdrawal of the § 103 rejections is therefore respectfully requested.

In view of the above amendments and remarks, allowance of all claims pending is respectfully requested.

Respectfully submitted,

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